App. No. 10/708,758
Amendment dated February 27, 2006
Reply to Office action of October 27, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the present application.

Listing of Claims:

Claim 1 (currently amended): A hydrodynamic bearing in a spindle motor having a rotation axis, comprising:

a shaft;

a sleeve relatively rotated with respect to said shaft;

a bearing portion including a micro gap formed between said shaft and said sleeve, a lubricating oil retained as a working fluid in said micro gap, and a dynamic pressure generating groove formed on at least one side of an outer peripheral surface of said shaft and an inner peripheral surface of said sleeve in said micro gap, for generating a dynamic pressure so as to support a rotation of said shaft or said sleeve;

a capillary seal portion adjoining said bearing portion, ~~wherein~~ the capillary seal portion comprising:

a first capillary seal portion adjoining said bearing portion, and having a first radial gap between an outer surface of said shaft and an first inner peripheral surface of said sleeve, ~~a dimension of said first radial gap being getting at least wider in accordance with increasing a distance from said bearing portion in said rotation axis~~ said first radial gap at least widening the further along said rotation axis the radial dimension of said gap is from said bearing portion; and

a second capillary seal portion adjoining said first capillary seal portion, and having a second radial gap between an outer surface of said shaft and an second inner peripheral surface of said sleeve, ~~a dimension of said second radial~~ gap ~~being getting at least wider in accordance with increasing a distance from said bearing portion in said rotation axis~~ said second radial gap at least widening the further along said rotation axis the radial dimension of said gap is from said bearing portion;

wherein

~~a first radial distance between the first inner peripheral surface and the rotation axis in radial direction, is getting at least shorter in accordance with increasing a distance from said bearing portion in said rotation axis~~ a first radial separation of the first inner peripheral surface from the rotation axis at least shortens the further along said rotation axis the first radial separation is from said bearing portion, and said first inner peripheral surface forms a first angle θ_1 ~~(employing a smaller angle having the angle value in a range $0 \leq \theta_1 \leq 90°$)~~, whose value is in the range $0 < \theta_1 \leq 90°$, with respect to said rotation axis, ~~and~~

~~a second radial distance between the second inner peripheral surface and the rotation axis in radial direction, is getting at least shorter in accordance with increasing a distance from said bearing portion in said rotation axis~~ a second radial separation of the second inner peripheral surface from the rotation axis at least shortens the further along said rotation axis the second radial separation is from said bearing portion, and said second inner

peripheral surface forms a second angle θ_2 ~~(employing a smaller angle having the angle value in a range $0 \leq \theta_2 \leq 90°$)~~, whose value is in the range $0 \leq \theta_2 < 90°$, with respect to said rotation axis, and

said first angle θ_1 and said second angle θ_2 have a relation $\theta_1 > \theta_2$.

Claim 2 (original): The hydrodynamic bearing as claimed in claim 1, wherein said second angle θ_2 has a relation $\theta_2 > 0$.

Claim 3 (canceled)

Claim 4 (original): The hydrodynamic bearing as claimed in claim 1, wherein at least in a stationary state, said lubricating oil forms a gas-liquid interface in said second inner peripheral surface.

Claim 5 (original): The hydrodynamic bearing as claimed in claim 1, wherein said shaft is provided with a shaft annular member integrally formed with said shaft or fixed as an independent body to the shaft, and a part or all of said capillary seal portion is formed between said shaft annular member and said sleeve.

Claim 6 (original): The hydrodynamic bearing as claimed in claim 5, wherein a sleeve annular member is attached to said sleeve, and a part or all of said capillary seal portion is formed between said sleeve annular member and said shaft annular member.

Claim 7 (original): The hydrodynamic bearing as claimed in claim 6, wherein a pair of said bearing portions are provided so as to be apart from each other with respect to said shaft in an axial direction, and a pair of said shaft annular members are attached to said shaft in correspondence to said pair of bearing portions.

Claim 8 (original): The hydrodynamic bearing as claimed in claim 7, wherein a pair of said bearing portions are provided so as to be apart from each other with respect to said shaft in said axial direction, and a pair of said sleeve annular members are attached to said sleeve in correspondence to said pair of bearing portions.

Claim 9 (original): The hydrodynamic bearing as claimed in claim 1, wherein an annular conical member in which an outer diameter is expanded in an axial direction is provided in said shaft so as to be integrally formed with said shaft or to be fixed to the shaft, and a part or all of said capillary seal portion is formed between said conical member and said sleeve.

Claim 10 (original): The hydrodynamic bearing as claimed in claim 9, wherein a cap member is attached to said sleeve, and a part or all of said capillary seal portion is formed between said cap member and said conical member.

Claim 11 (original): The hydrodynamic bearing as claimed in claim 10, wherein a pair of said bearing portions are provided so as to be apart from each other with respect to said shaft in an axial direction, and a pair of said conical members are attached to said shaft in correspondence to said pair of bearing portions.

Claim 12 (original): The hydrodynamic bearing as claimed in claim 11, wherein a pair of said bearing portions are provided so as to be apart from each other with respect to said shaft in said axial direction, and a pair of said cap members are attached to said sleeve in correspondence to said pair of bearing portions.

Claim 13 (currently amended): A spindle having a rotation axis comprising:

a stator fixed at a bracket with which one side of a shaft and a sleeve;

a rotor magnet secured another of said shaft and said sleeve and generating a rotating magnetic field in cooperation with said stator; and

[[A]] a hydrodynamic bearing comprising:

said shaft;

said sleeve relatively rotated with respect to said shaft;

a bearing portion including a micro gap formed between said shaft and said sleeve, a lubricating oil retained as a working fluid in said micro gap, and a dynamic pressure generating groove formed on at least one side of an outer peripheral surface of said shaft and an inner peripheral surface of said sleeve in said micro gap, for generating a dynamic pressure so as to support a rotation of said shaft or said sleeve;

a capillary seal portion adjoining said bearing portion, ~~wherein~~ the capillary seal portion comprising:

a first capillary seal portion adjoining said bearing portion, and having a first radial gap between an outer surface of said shaft and an first inner peripheral surface of said sleeve, ~~a dimension of said first radial gap being getting at least wider in accordance with increasing a distance from said bearing portion in said rotation axis~~ said first radial gap at least widening the further along said rotation axis the radial dimension of said gap is from said bearing portion; and

a second capillary seal portion adjoining said first capillary seal portion, and having a second radial gap between an outer surface of said shaft and an second

inner peripheral surface of said sleeve, ~~a dimension of said second radial gap being getting at least wider in accordance with increasing a distance from said bearing portion in said rotation axis~~ said second radial gap at least widening the further along said rotation axis the radial dimension of said gap is from said bearing portion; wherein

~~a first radial distance between the first inner peripheral surface and the rotation axis in radial direction, is getting at least shorter in accordance with increasing a distance from said bearing portion in said rotation axis~~ a first radial separation of the first inner peripheral surface from the rotation axis at least shortens the further along said rotation axis the first radial separation is from said bearing portion, and said first inner peripheral surface forms a first angle θ_1 ~~(employing a smaller angle having the angle value in a range $0 \leq \theta_1 \leq 90°$)~~, whose value is in the range $0 < \theta_1 \leq 90°$, with respect to said rotation axis, ~~and~~

~~a second radial distance between the second inner peripheral surface and the rotation axis in radial direction, is getting at least shorter in accordance with increasing a distance from said bearing portion in said rotation axis~~ a second radial separation of the second inner peripheral surface from the rotation axis at least shortens the further along said rotation axis the second radial separation is from said bearing portion, and said second inner peripheral surface forms a second angle θ_2 ~~(employing a smaller angle having~~

~~the angle value in a range $0 \leq \theta_2 \leq 90°$~~), whose value is in the range $0 \leq \theta_2 < 90°$, with respect to said rotation axis, and

said first angle θ_1 and said second angle θ_2 have a relation $\theta_1 > \theta_2$.

Claim 14 (original): The spindle motor as claimed in claim 13, wherein said second angle θ_2 has a relation $\theta_2 > 0$.

Claim 15 (canceled)

Claim 16 (currently amended): A disc drive apparatus to which a disc-shaped recording medium capable of recording information is attached, comprising:

a housing;

a spindle motor fixed to an inner portion of said housing and rotating said recording medium; and

a means for writing or reading the information at a desired position of said recording medium,

wherein said spindle motor comprises:

a stator fixed at a bracket with which one side of a shaft and a sleeve;

a rotor magnet secured another of said shaft and said sleeve and generating a rotating magnetic field in cooperation with said stator; and

[[A]] a hydrodynamic bearing comprising:

said shaft;

said sleeve relatively rotated with respect to said shaft;

a bearing portion including a micro gap formed between said shaft and said sleeve, a lubricating oil retained as a working fluid in said micro gap, and a dynamic

pressure generating groove formed on at least one side of an outer peripheral surface of said shaft and an inner peripheral surface of said sleeve in said micro gap, for generating a dynamic pressure so as to support a rotation of said shaft or said sleeve;

a capillary seal portion adjoining said bearing portion, wherein the capillary seal portion comprising:

a first capillary seal portion adjoining said bearing portion, and having a first radial gap between an outer surface of said shaft and an first inner peripheral surface of said sleeve, ~~a dimension of said first radial gap being getting at least wider in accordance with increasing a distance from said bearing portion in said rotation axis~~ said first radial gap at least widening the further along said rotation axis the radial dimension of said gap is from said bearing portion; and

a second capillary seal portion adjoining said first capillary seal portion, and having a second radial gap between an outer surface of said shaft and an second inner peripheral surface of said sleeve, ~~a dimension of said second radial gap being getting at least wider in accordance with increasing a distance from said bearing portion in said rotation axis~~ said second radial gap at least widening the further along said rotation axis the radial dimension of said gap is from said bearing portion; wherein

~~a first radial distance between the first inner peripheral surface and the rotation axis~~ in radial direction, is ~~getting at least shorter in accordance with increasing a distance from said bearing portion in said rotation axis~~ a first radial separation of the first inner peripheral surface from the rotation axis at

least shortens the further along said rotation axis the first radial separation is from said bearing portion, and said first inner peripheral surface forms a first angle θ_1 ~~(employing a smaller angle having the angle value~~ in a ~~range $0 \leq \theta_1 \leq 90°$)~~, whose value is in the range $0 < \theta_1 \leq 90°$, with respect to said rotation axis, ~~and~~

~~a second radial distance between the second inner peripheral surface and the rotation axis in radial direction, is getting at least shorter in accordance with increasing a distance from said bearing portion in said rotation axis~~ a second radial separation of the second inner peripheral surface from the rotation axis at least shortens the further along said rotation axis the second radial separation is from said bearing portion, and said second inner peripheral surface forms a second angle θ_2 ~~(employing a smaller angle having the angle value in a range $0 \leq \theta_2 \leq 90°$)~~, whose value is in the range $0 \leq \theta_2 \leq 90°$, with respect to said rotation axis, and

said first angle θ_1 and said second angle θ_2 have a relation $\theta_1 > \theta_2$.

Claim 17 (original): The disc drive apparatus as claimed in claim 16, wherein said second angle θ_2 has a relation $\theta_2 > 0$.

Claim 18 (canceled)